

U.S.S.N. 10,796,470

Remarks

Thorough examination by the Examiner is noted and appreciated.

The Specification has been amended to overcome Examiners objections.

The claims have been amended to overcome Examiner objections and to clarify Applicants disclosed invention.

Support for the new claims is found in the Specification, the Figures and the original claims.

No new matter has been added.

For example support for the amendments and new claims is found in the Specification at:

Paragraph 0019:

"According to the method of the invention, an electrolyte electroplating bath solution is prepared, and the suppressor additive copolymer is mixed with the bath solution. The substrate having the electroplating surface is immersed in the solution and subjected to electrochemical plating. During immersion of

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the substrate, the solution, which is characterized by a high capillary rise and low interfacial energy as compared to electroplating bath solutions having a conventional, commercially-available suppressor additive, rapidly wets the electroplating surface. This ensures optimal wetting of all regions on the electroplating surface, including high aspect ratio gap features, and results in uniform electroplating deposition and gap-filling with minimal tendency for immersion-related electroplating defects."

Paragraph 0019:

"In a preferred embodiment, the suppressor additive composition of the present invention is present in the electroplating bath solution in a concentration of from typically about 50 ppm to about 500 ppm. An accelerator is typically present in the electrolyte bath solution in a concentration of from typically about 2 ppm to about 50 ppm. The accelerator may be any type of commercially-available accelerator known by those skilled in the art for accelerating a metal electroplating deposition process."

Paragraph 0032:

"Referring to FIGS. 1, 1A and 2, according to the method of the present invention, a metal seed layer 19, such as copper, is deposited on a wafer substrate 18, as indicated in step S1 of FIG. 2. The metal seed layer 19 may be deposited on the substrate 18 using conventional chemical vapor deposition (CVD) or physical vapor deposition (PVD) techniques, according to the knowledge of those skilled in the art. The seed layer 19 has a thickness of typically about 50-1500 angstroms."

Paragraph 0034:

"As indicated in step S4 of FIG. 2, the cathode/substrate 18 is immersed in the bath solution 20. Accordingly, the seed layer 19 on the substrate 18 contacts the bath solution 20. The entire surface of the seed layer 19, as

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well as gap features on the substrate 18, are **thoroughly wetted** by the bath solution 20. It will be appreciated by those skilled in the art that the suppressor additive copolymer composition 25 permits optimal wetting of the ECP electrolyte bath solution 20 to the seed layer 19 during immersion of the substrate 18 and throughout the electroplating process, as the bath solution 20 lacks commercially-available suppressor additives which have been shown to hinder the wetting capabilities of an electroplating bath solution."

#### Claim Objections

Claims 1 and 14 have been amended as suggested by Examiner to overcome Examiners objections.

#### Claim Rejections under 35 USC 102

1. Claims 1-4 and 9-10 stand rejected under 35 USC Section 102(b) as being anticipated by Quimby (US 3,554,884).

Quimby discloses a process Betts process) for electrolytic ally refining impure lead where impure lead anodes are plated out on a cathode (see col 1, lines 30-48). The method of Quimby discloses using **a mixture of a lignosulfonate and a water soluble block copolymer or (of) propylene oxide and ethylene oxide** as an additive to achieve smoother deposition of lead at the cathode (see col 2, lines 14-30). Quimby teaches the use of commercially

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available block copolymers of propylene oxide and ethylene oxide including the tradenames Pluronic-64 (having an ethenoxy content of about 40%) and Pluronic F-68 (having an ethenoxy content of about 80%) (col 3, lines 31-62).

Quimby fails to disclose several aspects of Applicants disclosed and claimed invention including an electrolyte solution comprising a source of copper ions and is therefore insufficient to anticipate Applicants disclosed and claimed invention.

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987).

"The identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

2. Claims 13-16 stand rejected under 35 USC Section 102(b) as being anticipated by Quimby (US 3554, 884).

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Applicants reiterate the comments made above with respect to Quimby.

3. Claims 13-14 and 16 stand rejected under 35 USC Section 102(b) as being anticipated by Barstad et al. (US 6,444,110) in combination with BASF Technical Bulletin at page 1.

Applicants note that Examiner is making a 102(b) rejection by the combination of references, in which case the BASF Technical Bulletin is used only for definitional purposes.

Barstad et al. disclose a composition and a method for electroplating copper into high aspect ratio vias. Barstad et al. disclose a method for electroplating copper and an electroplating composition with **elevated brightener concentrations in combination with a suppressor agent**, which is taught to **achieve accelerated bottom filling (i.e. non-uniform deposition)** of copper electrodeposition in vias (see Abstract; col 3, lines 19-30). Barstad et al. disclose that a **first metallic coating** may first be provided on the substrate by an **electroless deposition process** or that the copper may be **deposited directly onto the via (i.e., without a seed layer)** (see

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col 7, lines 36-42).

Barstad et al. disclose the use of high molecular weight polyethers (see col 6, lines 23-38; (claims 4, 13, 31) as suppressor agents. Barstad et al. also disclose of **polyethylene glycol copolymers** and **polyethylene glycol copolymers** disclosed to be commercially available from BASF under Tetronic and Pluronic tradenames. Barstad et al. generally teach a concentration of the suppressor additive (not specifically disclosed which suppressor additive) over a broad range of 1-10,000 ppm (col 6, lines 60-63) but do not teach the relative concentrations of the elevated brightener concentration (which accelerates copper coating) relative the concentration of suppressor (which may slow the rate of deposition) see e.g., (USPUB 2002/0056645).

BASF Technical Bulletin discloses surfactants of **block copolymers of propylene oxide and ethylene oxide**, otherwise referred to under the trade name Pluronic (see page 1). BASF Technical Bulletin discloses the structure of **Pluronic** surfactants (at Figures 2 and 3) **where in a block copolymer structure propylene oxide is sandwiched between 2 ethylene oxide groups (propylene oxide groups formed by substituting (adding)**

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propylene oxide onto the two hydroxyl groups on propylene glycol).

By contrast **Tetronic** surfactants have a significantly different structure (Figure 5) and are formed by adding propylene oxide and ethylene oxide to **ethylene diamines**. BASF Technical Bulletin discloses that Pluronics are useful as anti-foaming agents with a wide variety of uses **including metal cleaning (page 10) prior to a plating process**.

Even ignoring the discrepancy between the definition present in the BASF Technical Bulletin of block copolymers consisting of propylene oxide and ethylene oxide versus ethylene glycol and propylene glycol copolymers as taught by Barstad et al., Barstad et al. does not disclose the elements of Applicants disclosed and claimed invention and is therefore insufficient to anticipate Applicants disclosed and claimed invention.

For example, Barstad et al. does not disclose

**"wherein said suppressor additive is at a higher concentration than said accelerator agent."**

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4. Claims 17-20 stand rejected under 35 USC Section 102(b) as being anticipated by Barstad et al. (US 6,444,110) in combination with BASF Technical Bulletin at page 1.

Applicants reiterate the comments made above with respect to Barstad et al. and BASF Technical Bulletin.

5. Claims 17 and 18 stand rejected under 35 USC Section 102(b) as being anticipated by Barstad et al. (US 6,444,110) in combination with BASF Technical Bulletin at pages 1-37.

Applicants reiterate the comments made above with respect to Barstad et al. and BASF Technical Bulletin.

**Claim Rejections under 35 USC 103**

6. Claims 5-8 and 11-12 stand rejected under 35 USC Section 103(a) as being unpatentable over Quimby, above.



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Applicants reiterate the comments made above with respect to Quimby, above.

Further with respect to claim 5 and 11, Quimby nowhere discloses "wherein said copolymer is a random copolymer".

Further with respect to claims 7 and 12, Quimby nowhere discloses or suggests "wherein said copolymer is an alternating copolymer."

"Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure." *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

7. Claims 3 and 5-12 stand rejected under 35 USC Section 103(a) as being unpatentable over Barstad et al. (US 6,444,110) in combination with BASF Technical Bulletin at page 1, above and further in view of BASF Technical Bulletin at pages 1-37.

Applicants reiterate the comments made above with respect to

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Barstad et al. and BASF Technical Bulletin.

Applicants further note that nowhere do Barstad et al. recognize or suggest a solution to the problem that Applicants have recognized and solved:

"An electrolyte for copper electroplating with improved wetting of a copper seed layer and improved deposition uniformity of said electroplated copper"

Even assuming *arguendo* that Barstad et al. discloses a seed layer, which Applicants do not concede, Barstad et al. teach that a metal layer by **electroless deposition need not be present** according to the method of Barstad et al.

Moreover, the method of Barstad et al. is specifically taught to **accelerate bottom filling** of a via by the combination of an elevated brightener concentration in combination with an undisclosed relative concentration, and therefore does not accomplish Applicants invention of **improved deposition uniformity, but rather achieves the opposite result.**

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Further with respect to claims 5 and 11, the combined teachings of Barstad et al. and BASF Technical Bulletin do not disclose or suggest "wherein said copolymer is a **random copolymer or an alternating copolymer**" as distinct from a block co-polymer. The BASF Technical Bulletin specifically is referring to the block copolymers with the respective tradenames of Pluronic and Tetronic, and discusses the possibility of rearranging species within the block copolymer to achieve a customers requirements. Nowhere does the BASF Technical Bulletin disclose or suggest random copolymers or alternating copolymers as distinct from block copolymers and nowhere does the BASF Technical Bulletin disclose or suggest that their block copolymers could be suitably used during an electroplating process or a copper electroplating process.

"Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure." *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

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8. Claim 15 stands rejected under 35 USC Section 103(a) as being unpatentable over Barstad et al. (US 6,444,110) in combination with BASF Technical Bulletin at page 1, above and further in view of BASF Technical Bulletin at pages 1-37.

Applicants reiterate the comments made above with respect to Barstad et al. and BASF Technical Bulletin.

9. Claims 19 and 20 stands rejected under 35 USC Section 103(a) as being unpatentable over Barstad et al. (US 6,444,110) in combination with BASF Technical Bulletin at page 1, above and further in view of BASF Technical Bulletin at pages 1-37.

Applicants reiterate the comments made above with respect to Barstad et al. and BASF Technical Bulletin.

"Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure." *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

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### Conclusion

The cited references, singly or in combination, fail to produce Applicants disclosed and claimed invention thereby failing to make out a *prima facie* case of anticipation or obviousness and further nowhere do the combined teachings of the references recognize or provide a solution to the problem that Applicants have recognized and solved by their disclosed and claimed invention.

Applicants have amended their claims to clarify Applicants invention and clearly define over the prior art.

Based on the foregoing, Applicants respectfully submit that all of Applicants Claims are now in condition for allowance. Such favorable action by the Examiner at an early date is respectfully solicited.

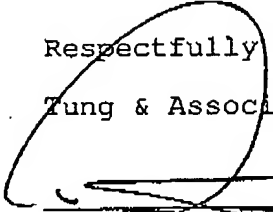
In the event that the present invention as claimed is not in a condition for allowance for any other reasons, the Examiner is respectfully invited to call the Applicants' representative at his Bloomfield Hills, Michigan office at (248) 540-4040 such that

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necessary action may be taken to place the application in a  
condition for allowance.

Respectfully submitted,

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